

Foresight Exercises as a tool for decision-making: the example of two case studies in health⁴

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Abstract

Healthcare systems are characterized by a rapid technology push and demand. Most decisions taken in this field usually are accompanied by risk and uncertainties. Due to financial constraints (common in every healthcare system), all decision must be made based on evidences of reliable studies. It may be not possible to know the future needs of healthcare systems in general, but it should be possible to foresee them. This paper aims to shed some light on how prospective analysis can be an adding tool for the decision-making process, by enhancing exploratory and strategic dimension of planning and managing in a sensitive field such as healthcare. In order to provide for a simple overview on foresight exercises applied to health, this paper presents two study-cases that applied different methods. Since different foresight methods were applied, a comparative case-study analysis was applied, taking into consideration the following aspects of the exercise: aim, methodology, stakeholders and outputs. The specific objectives of this report are: to explore the usage of foresight methods applied to healthcare level in two different countries and therefore to understand if there are any similarities in the approach; and based on the analysis results, to develop recommendations for healthcare level decision-making in general. The results of this report can be useful for a better understanding on how foresight methods can be applied in healthcare and their importance. This article can help healthcare professionals, providing them a glimpse of some steps on the use of these foresight methods, so they can be more alert for foresight methodological framework and their practical applications. The knowledge on how to apply foresight methodology can be a differential and potential asset of a well-organized and informed institution, as well as an asset for a shared and participative strategic planning.

Key-Words: Foresight, Technology Assessment, Healthcare System, Research methods, Decision making.

JEL codes: C53, C63, I11, I38, M48, O21

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Introduction

"Future is not ours to say but preparation is a must!"

(Larcy Pascual)

Every day, medicine is experiencing something new or different, as new technologies and new procedures are introduced in health professionals work routines. Healthcare management try to go side by side with the general society demands. At some point in our lives, each one of us will be in need of health care services. No human being is immune to diseases. Each one of us lives and carries out a life trying to avoid the absence of health. This is why the main concern in societies is to prevent, treat and diagnose illnesses.

There are many and different stakeholders in healthcare and all of them at some point have different doubts and questions and are in seeking of discovering the answers for questions like: How will this practice in medicine evolve? Which technologies will still be available to diagnose this disease, in the future? How can we understand an emerging disease threats? In general: what can we do to achieve desirable health futures?

To have an efficient management of health technology, it is necessary to apply foresight methods. Only then, decision makers will be able to try to "see" and understand the future and for that, be better prepared at its arrival. Taking a glimpse in to the future, allows decision makers, providers, scientist, health professionals, etc. to develop and manage new policies, new treatments, new products, etc, and above all, new health technologies.

Foresight is neither prophecy nor prediction. It does not aim to predict the future like if it was predetermine. Instead, it helps us to consider the future giving the possibility to create and shape it. The goal is not to foresee what will happen, but to prepare for what might happen – and to develop a common understanding of what should happen if threats are to be mitigated and opportunities seized (Masum, Ranck, and Singer 2010).

Taking into account the reality that medicine is experiencing nowadays, especially regarding the necessity of budget constraints, it is easy to understand why foresight is so helpful and needed in healthcare management.

The main objective of this paper is to understand in what circumstances foresight methods can be applied in healthcare exercises, presenting two study-cases that used different approaches. In order to do so, the following aspects were taken into consideration: aim, methodology and stakeholders involved and outputs.

The specific objectives of this report are: to explore the usage of foresight methods in health area in two different countries and therefore understand if there are any similarities in the approach; and based on the results of analysis, to develop recommendations for health care level foresight exercises in general. This paper is structured in four main parts. The introduction tries to sum up the importance of foresight in healthcare practices. The second part provides an overview of the most usual methods in healthcare area. In the third part a comparative analysis of the two case studies on healthcare level foresight in Canada and South-Africa is made, followed by conclusions and some recommendations about methods and foresight in health.

(Health) Foresight Studies

"Prediction is very difficult, especially about the future."

(Niels Bohr)

In this chapter, it is presented the specifications of health foresight exercises in terms of the methods used. In a very simple way, a "health system" can be defined as all the activities whose primary purpose is to promote, restore and/or maintains health. The World Health Organization defines health system as "the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve, while responding to people's legitimate expectations and protecting them against the cost of ill-health through a variety of activities whose primary intent is to improve health" (Banken and Juzwishin 2011).

Healthcare is a very complex system, with many peculiarities. Because of the complexity that surrounds decisions in healthcare, one can ask if, there are differences of foresight exercises foresight in health and others areas. For some authors, Health presents a set of singularities that makes it special in a way. Masum, Ranck, and Singer (2010) argue in favour of this difference, when they say that the first difference as to do with the multiplicity of stakeholders, namely, physicians, patients, technology developers, pharmaceutical and medical devices industries, policy-makers, scientists, health insurances, etc. This implies not only differences regarding background knowledge but also different interests. Second, because the applicability of healthcare is universal, as everyone interacts with health systems. Thirdly, because of the financial factor who plays an important key role in health decision-policy.

Every health system, whether in develop or developing countries struggles with the challenge of healthcare management, taking into account the resources constrains conditions. Throughout the world the goal is to maximize health benefits and impacts regarding health technologies⁵, with the minimum costs (Masum, Ranck, and Singer 2010).

There are many foresight methods that can be applied in a variety of studies. Some more popular than others. In every foresight exercise there are some transversal phases such as the definition of objectives, the gathering of a project team (preferential researchers should be asked and knowledgeable in foresight) and the selection of the most suitable methodology, that enables answers to the questions at stake and on the resources available for the study (namely budget). In general, there are approximately 33 possible methods to apply in a foresight exercise (listed in Table 1). Sometimes, it can be very difficult to choose the most suitable one.

These methods can be classified according to the type of technique (data collection) in: quantitative, qualitative and semi-quantitative. Usually in foresight, this classification is made according to the use of more or less narrative and discursive texts, the latter to the analysis of trends and similar data (Popper 2008, p.52).

Qualitative	Quantitative	Semi-quantitative
Methods providing meaning to events and perceptions. Such interpretations tend to be based on subjectivity or creativity that is often difficult to corroborate (e.g. opinions, brainstorming sessions, interviews)	Methods measuring variables and applying statistical analyses, using or generating (hopefully) reliable and valid data (e.g. socio-economic indicators)	Methods that apply mathematical principles to quantify subjectivity, rational judgements and viewpoints of experts and commentators (i.e. weighting opinions or probabilities)
1. Backcasting 2. Brainstorming 3. Citizens Panels 4. Conferences/Workshops 5. Essays/Scenario Writing 6. Expert Panels 7. Genius Forecasting 8. Interviews 9. Literature Review (LR) 10. Morphological Analysis 11. Relevance Trees/ Logic Charts 12. Role play/Acting 13. Scanning 14. Scenario/Scenario workshops 15. Science Fictioning (SF) 16. Simulation Gaming 17. Surveys 18. SWOT analysis 19. Weak Signals/Wild Cards	20. Benchmarking 21. Bibliometrics 22. Indicators/Time Series Analysis (TSA) 23. Modelling 24. Patent Analysis 25. Trend Extrapolation/ Impact Analysis	26. Cross-impact/ Structural Analysis (SA) 27. Delphi 28. Key/Critical technologies 29. Multi-criteria analysis 30. Polling/Voting 31. Quantitative scenarios/SMIC 32. Roadmapping 33. Stakeholder Analysis/ MACTOR

Table 1 - Classification of foresight methods by type of technique according to Popper (2008, p. 54).

⁵ Health Technologies can be understood has drugs, devices, procedures, and the organizational and support systems within which health care is delivered (Velasco et al. 2002).

Taking into consideration the core type of knowledge source that each method is mainly based upon, Popper (2008) positioned the 33 earlier listed methods, in a Foresight Diamond, as shown in Figure 1:

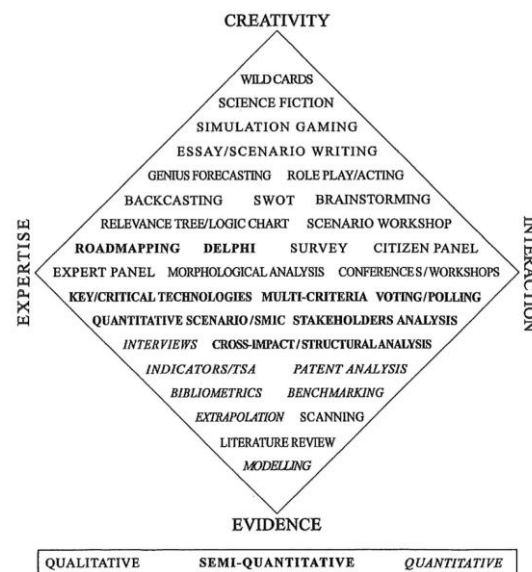


Figure 4 – Popper’s Foresight Diamond (Popper 2008, p. 71)

Despite the amount of methods available, according to Masum *et al* (2010), there are five promising methods to apply when doing a health foresight exercise. These are: forecasting, scenarios, Delphi, technology road mapping and mass collaboration. Some of the discussion made by the authors were summarized in Table 2, where it is addressed the strengths and weakness for each method and also when they might be used.

Table I Comparison of five foresight methods for health		
Method	When should I use it? What's the "product"?	Strengths and weaknesses
Forecasting – trend analysis	You have a model and enough data to extrapolate Product: quantified forecasts, often with error ranges	+ Statistical and modeling tools to draw on – Many domains cannot be modeled quantitatively
Scenarios – stories about plausible future worlds	You want to get a qualitative range of plausible outcomes Product: narratives that span a range of plausible futures	+ Possible future worlds that can expand range of thinking – Requires good facilitation and diverse experts; difficult to evaluate plausibility of results
Delphi – a ranked list of options	You want to combine the insights of experts on a well-defined question Product: consensus answers, often ranked	+ Concrete consensus answers, and transparent process – Time-consuming; seldom creates out of the box results
Technology roadmapping – a blueprint for making a technology a reality	You want to understand implementation steps for a technology Product: a detailed roadmap with narrative and technical elements	+ A plan for getting "from here to there". Network of experts as side benefit – Significant funding and time. Plan may not be robust to future developments
Mass collaboration – barrier-free collaboration, at any scale	You want to leverage technology and structure interactions for better collaborations Product: tested tools and processes, new kinds of foresight outputs, and public engagement	+ Many promising prototypes. Tools keep improving – Tough to change entrenched social habits. Tacit knowledge needed for best interactions

Table 2 - Comparison of five foresight methods for health (Masum, Ranck and Singer 2010)

As in general foresight, the methods used in health exercises are not mutually exclusive, since depending on the research issue, they can complement each other.

Case Studies Presentation

Having described some of the singularities of foresight in health care, it is worth wordy to understand how it can be applied in real cases. The aim of this section is to present two case studies: the first focus on the demands of hip replacement surgery, in Ontario, Canada and the second as a more broad analysis, focusing the specific technologies and technology trends that will best improve the quality of life of all South Africans. In the first case-study the methodology used was forecasting and in the second it was scenarios (also combined with other methods).

Both case studies will be presented taking into consideration four areas, namely: 1) Framework – it is intended to make a short introduction of the subject and aim of the case study; 2) Methodology – in this section, the methodology used in the foresight exercise will be presented; 3) Outputs – the outputs that have resulted from the exercise will be identified and 4) Conclusions – the main conclusion extracted from the exercise will be presented.

The analysis of the two different foresight exercises is also made in an attempt to answer the following questions: Was the problem and aim clear? What methods were used? Who were the stakeholders involved in the study? What were the main outputs? And finally, were there limitations associated in the study? After the presentation of the case studies, a brief comparison is made.

Case-Study 1: Forecasting Hip Replacement with the Ontario Ministry of Health and Long-Term Care

Framework

Due to the improvements in surgical techniques, combined with an aging population, Canada assists to a rapid growth in the need for orthopaedic services. As a consequence, a dramatic increase in services demand for orthopaedic surgery, raised concerns about the healthcare systems ability to meet long-term demand, mainly for hip and knee procedures. Statically, between 1994 and 2004, hip replacement surgeries had increased by some 43 percent across Canada. Ontario is the most populated province in Canada. Only in Ontario, in 2002, surgeons performed approximately 8.500 hip replacements surgeries, which represent 42% of the total national demand of 20.000 cases.

The increase of demand for this surgical procedure created pressures on orthopaedic services, which resulted in unacceptable long waiting times for surgery. One key factor that contributed to this situation, was the availability of orthopaedic surgeons in Ontario.

The Ministry of Health and Long-Term Care had to face with public expectations for improved service levels, but also with leak of knowledge about the future demands of hip replacement surgery. Both patient and providers dissatisfaction became public, regarding the lengthy wait times and limited system capacity. In the beginning of 2005, the Ministry was confronted with three factors that could inhibit its ability to effectively plan wait-times improvements:

1. Retrospective data indicated a well-established demand trend for hip replacement, which significantly increased during the prior three year period.
2. Little reliable information about what the determinants of need for hip surgery were and how the inter-relationship between three factors might influence future demand.
3. Reliable wait-time information was not generally available, since it was not usually collected. Even when collected, the look of standards made data inconsistent and only marginally useful.

As a consequence of this state-of-art, the Ministry try to find a reliable method for forecasting future demands for hip replacements. The forecasts would have to be scientifically derived and rigorous enough to guide Ontario's major strategic decisions on investment in medical manpower, facilities and

services.

The forecast would be vital for predicting demand on orthopaedic surgeries and planning for the related services that could enable the province to achieve its strategic performance mandate of reducing patient wait-time for the identified procedures.

In order to find a solution, the Ministry engaged a leader analytic software company- SAS Institute, who has many business solutions that enable long-scale software solutions for areas such as IT management, human resources management, financial management, business intelligence, customer relationship management and more. The goal was for SAS to examine the feasibility of developing a predictive analysis forecast for hip replacement surgery over the next 14 years (2005 - 2019).

In a first phase, SAS worked with the Ministry to scope out a project that would gain insight into predict the factors to help identify individuals requiring hip replacement surgery by:

1^o - developing an understanding of the primary determinants of need for hip replacements;

2^o - acquiring relevant data;

3^o - creating a forecast that would identify future demands for hip replacement surgery across Ontario, over the next 14 years;

4^o - documenting experimental learning from the hip replacement forecast project that would provide value to similar planning challenges in other health programmes.

As a result, SAS proposed a custom solution known as HIPP – Health Insight and Prediction Platform that would be conducted by a joint team of Ministry and SAS forecasting specialists.

Methodology

In order to develop the study, a four-step methodology was developed (Figure 2):



Figure 5 - Four-Step methodology scheme

First, a data extraction was made in order to create a raw file of relevant data extracted from multiple sources. Second, a data mining to derive a balanced subset of statistically significant data followed by forecasting, to run the data against multiple mathematical models and to test the results for fit. In the end, a report was written to provide results to the client (The Ministry). To understand the methodology used, each one of the four-step will be analysed, with a little more depth.

Data Extraction

Three more relevant information sources were selected from the wide spectrum available to the Ministry. These sources were: physicians billing records; acute care administration / separation records and statistics on Canada population forecast (the data was only extracted for the previous time period of 10 years). With the physician billing records, it is intended that the data from procedures related to hip surgery would be used to obtain information about the beginning of hip disease and referral to surgery.

The data from acute care admission was used to acquire details of hip-replacement surgeries carried out in Ontario's hospitals. Hospitalization and day-procedure records provided data to the indicators "hospital stay" and "procedures".

Statistics on Canada population forecast were used to provide census-based projections of the age/sex and demography of Ontario's geographic population (sourced from Canada statistics). In addition, the Ontario Health Registered Persons file (sourced from the Ministry and devoid of personal information) was used for accurate and non-attributable linkage of patient/physician and patient/procedure relationship. In total, the data set contained 33.000 observations. Finally, a linked data set was created from these observations using 67 variables and all data was consolidated into one record per patient.

Data Mining

In a very simple way, data mining refers to extracting or "mining" knowledge from large amounts of data (Han 2006). In general, the goal of the data mining process is to extract information from a data set and transform it into an understandable structure for further use. Therefore, it is the process of exploring large amounts of data in search of consistent patterns like association rules or temporal sequences, to detect systematic relationships between variables, thereby detecting new subsets of data.

After create a linked data set of essentially raw data, the data set was then

screened to eliminate those cases from further consideration that had insufficient, inconsistent or missing information or were outside the sample age window (40 years old at year 0 of time scale). Then, cross-correlations were run between all variables in an effort to uncover previously unknown data relationships (Figure 3). This step provided insight into the variables that would ultimately be best suited to increased forecasting accuracy.

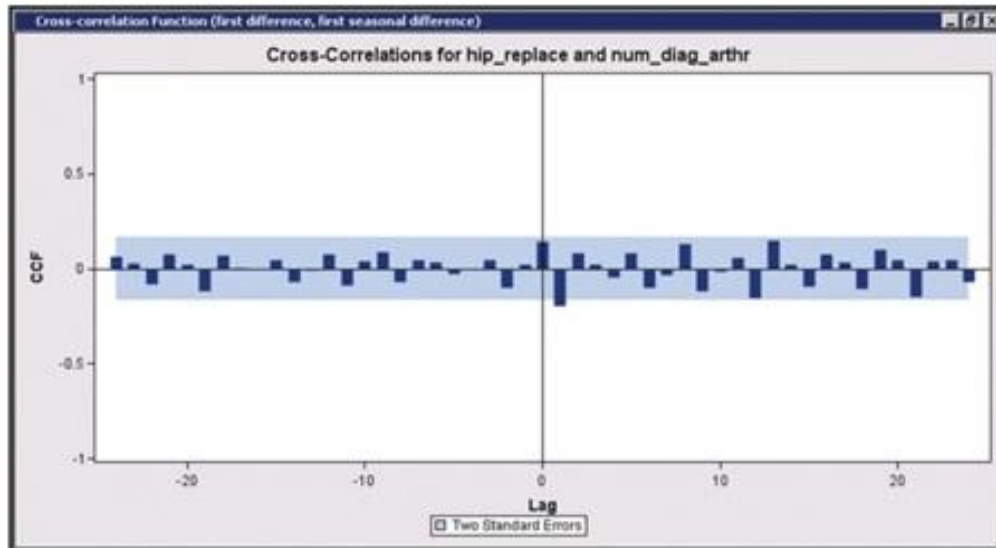


Figure 6 - Cross-correlations for hip-replacement
(source: SAS Institute 2009)

The Pearson correlation coefficient measures the degree of correlation (and the direction of this correlation - whether positive or negative) between two variables. The value of ρ can take three values and therefore three different interpretations:

$\rho = 1$ means a perfect positive correlation between the two variables;

$\rho = -1$ means a perfect negative correlation between the two variables: that is, if one increases, the other decreases always;

$\rho = 0$ means that both variables are not linearly dependent on one another. However, there may be a non-linear dependence.

Thus, $\rho = 0$ result should be investigated by other means.

The horizontal band over zero represents the confidence limits by approximately 95% for $H_0: \rho = 0$. If no estimated autocorrelation falls outside the defined range (two standard errors) and the data contain no outliers, it can safely be assumed that there is no serial correlation.

In summary and taking into consideration figure 3, one can see that variables are not co-related. SAS data set editing tools were used to prepare the data for statistical analysis. Oversampling was used to select a balanced data set for time series analysis. Missing data was resolved so that models requiring data integrity, such as neural networks⁶ and regression techniques⁷, could be used reliably.

Some selective editing of the data set values was carried out to make the data suited to mathematical modeling⁸. Variables with extreme outlying values were replaced or removed during the mining process (figure 4). Those values that were found to have a highly skewed distribution were adjusted through mathematical transformation.

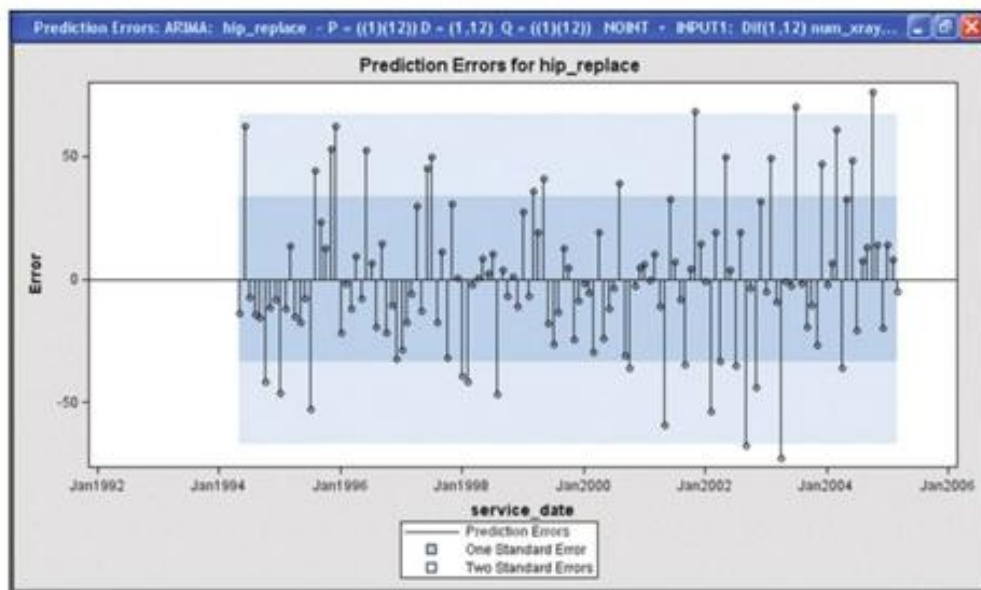


Figure 4 - Prediction errors for hip replacement (SAS Institute 2009)

⁶ Neural networks are computational systems in a structured approach to computing based connections. Simple nodes (or neurons, units or processors) are interconnected to form a network of nodes - hence the term neural network. The original inspiration for this technique comes from the examination of brain structures, in particular the examination of neurons.

(http://pt.wikipedia.org/wiki/Redes_neurais)

⁷ In statistics, regression is a technique that lets explore and infer the relationship between a dependent variable (response variable) with specific independent variables (explanatory variables). Regression also designates a mathematical equation that describes the relationship between two or more variables (<http://pt.wikipedia.org/wiki/Regress%C3%A3o>).

⁸ Mathematical modelling is the knowledge area that studies the simulation of real systems in order to predict their behaviour, being employed in various fields of study such as physics, chemistry, biology, economics and engineering.

(http://pt.wikipedia.org/wiki/Modelagem_matem%C3%A1tica)

All data within the light stripes were considered outliers and therefore were eliminated.

Forecasting

The first step in forecasting was to explore the time series generated from data mining. Using tests such as autocorrelation⁹ and white noise tests¹⁰, the data was validated for modeling suitability (figure 5).

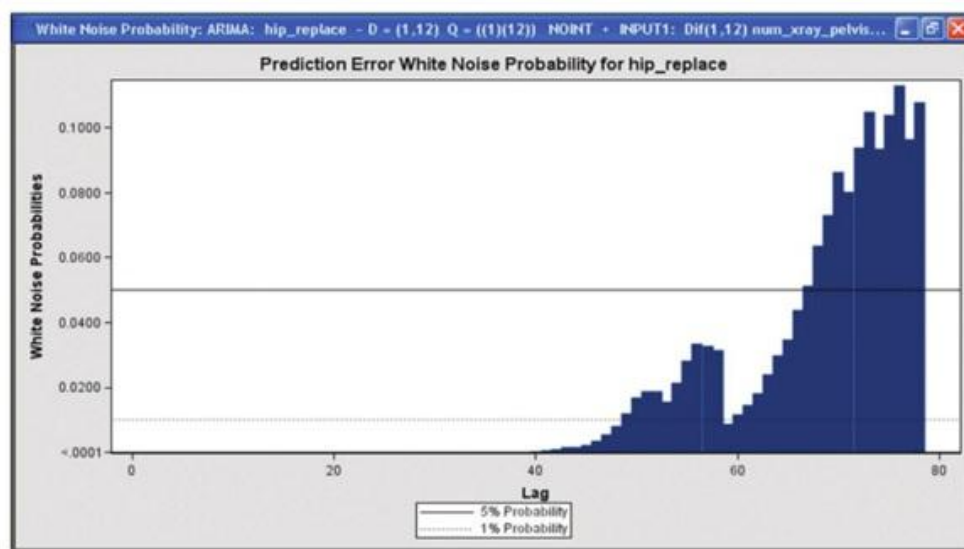


Figure 5 - White noise probability graphic (source: SAS Institute 2009)

In the graphic, the white noise probability represents the hip replacement. In an ideal situation, probability should be kept in 0%, which means that there isn't any noise. The forecast modeling process then examined a number of different time series modeling techniques to identify which produced the best demand forecast for hip replacement surgery. Modeling techniques involve decomposing the time series into its constituent components: a trend component to show the overall movement of the series direction over time, a seasonal component to capture the series cyclic properties, and an irregular component which was the result of an underlying stochastic process and/or the effects of input time series.

⁹ In statistics, autocorrelation is a measure that informs how much the value of a realization of a random variable is able to influence its neighbours. For example, as the existence of a higher value also affects high values of its neighbours.

¹⁰ Tests for white noise are statistical tests such as tests for serial correlation (Portmanteau test, Ljung-Box Q-test and modified test).

Some of the time series models and forecasting techniques included Box-Jenkins, ARIMA¹¹ models, exponential smoothing models¹², intermittent demand models, and unobserved components models. Each model was assessed on the accuracy of the forecast against a holdout data set, the statistical error of the forecast, and on statistical measures of accuracy such as MAPE.¹³ The automatic ARIMA model was finally favoured over all others because of its low MAPE score. This process involved trial and error and several iterations until a model emerged that was simple, performed well, satisfied statistical assumptions and yielded reasonable forecasts. After several iterations, only the manually generated ARIMA model showed any improvement in MAPE over the automatic model with an all-round better fit (Figure 6).

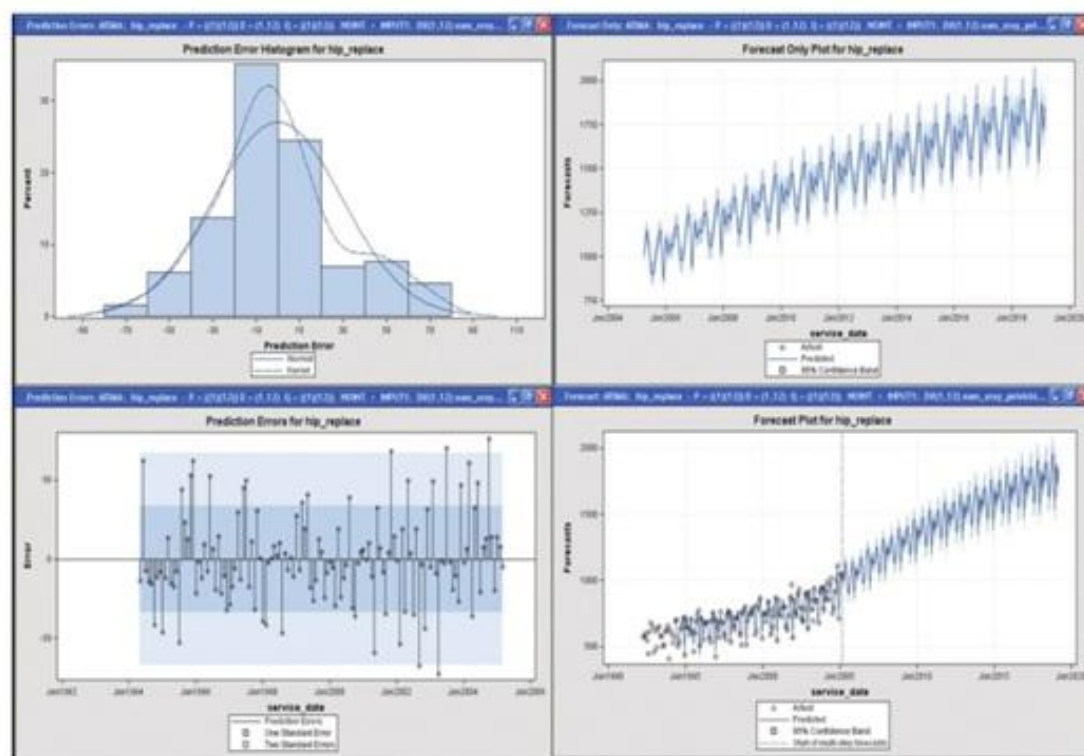


Figure 6 - Error forecast and forecast for hip replacement graphics (SAS Institute 2009)

¹¹ ARIMA – Autoregressive integrated moving average

¹² Exponential smoothing is a technique that can be applied to time series data or to produce smoothed data for presentation, or to make predictions. The time series data themselves are a sequence of observations. This phenomenon may be an essentially random process, or may be an ordered process but rather turbulent. (http://en.wikipedia.org/wiki/Exponential_smoothing)

¹³ The percentage of mean absolute error - MAPE - is in statistics, the measurement precision in a suitable time series value, specifically of trends. Usually it expresses percentage accuracy. (http://en.wikipedia.org/wiki/Mean_absolute_percentage_error)

Both graphics to the left report the error forecast for “hip replacement”. Those to the right represent the forecast to hip replacement surgeries with an associated confidence tax of f 95%. There is a tendency for the increase of hip replacement surgery indicated by the data linear regression. The final step of the methodology is reporting, as seen in Figure 1. This step will be developed next, as the output.

Outputs

A report was delivered to the Health Ministry by SAS, containing the forecasting project conclusions. The report included:

- A series of graphic time plots of the forecast, along with graphic illustrations of model behaviour.
- A tabular forecast by month – out to 2020 – detailing the forecasted incidence of hip surgery, along with confidence intervals, standard error and other key descriptive qualifiers.
- A detailed SAS consulting report containing:
 - A methodological description of the total process.
 - A significant amount of collateral information on the data set.
 - A review of the relevance, or lack thereof, of various models.
 - Descriptive information on the data set with the results of cross-correlations and prediction-error calculations of most of the 67 variables.

Building on a review of the HIPP methodology and results, the Health Ministry was then able to refine its forecasting requirements and develop long-term models for hip and knee forecasting.

Conclusions

HIPP (Health Insight and Prediction Platform) is a technique combination and a SAS statistical tool. When applied together with the knowledge of the health system in study and its data, it offers a solution to help to forecast many diseases and health problems incidence. The methodology used in the forecast exercise is summarized in Figure 7:

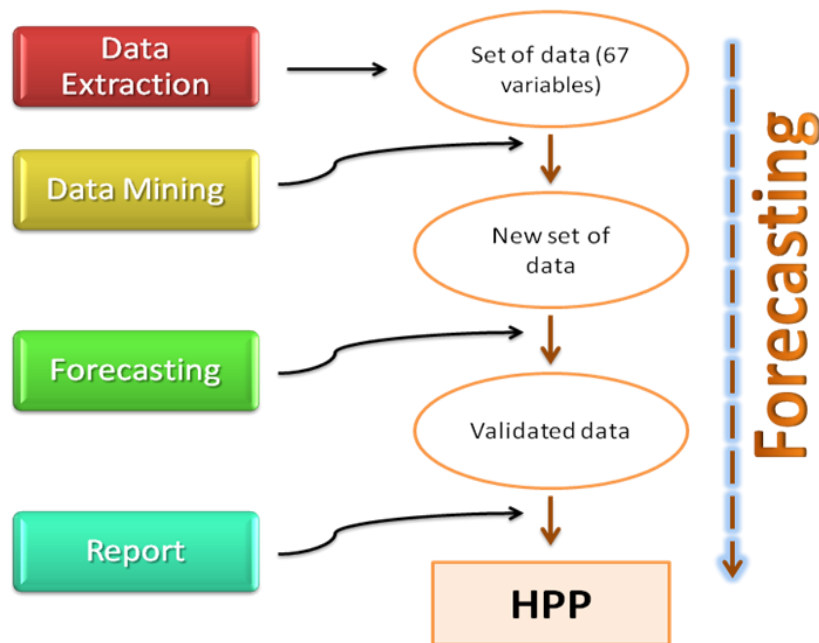


Figure 7 – Foresight study resume on Case-study 1

Case-Study 2: South Africa's National Research and Technology Foresight Project – Foresight Health Section

Framework

The National Research and Technology Foresight Project was one of a number of initiatives undertaken by the Department of Science and Technology's predecessor, the Department of Arts, Culture, Science and Technology. Part of its mission was to review and reform South Africa's science and technology system. Interest in South Africa (SA) foresight exercise has received special emphasis in July 1993, on the Mission Report on Science and Technology Policy sponsored by the International Development Research Centre of Canada. The intention to carry out such an exercise was announced by the Ministry of Arts, Culture Science and Technology in mid 1994, shortly after the establishment of the new Health Ministry.

The aim of the Foresight Project was to help identify those specific technologies sector and technology trends that will best improve the quality

of life of all South Africans over the next 10-20 years (Karim 2000). The project encompassed technologies that impact on social issues and wealth creation through product or process development. In particular it seek to:

- identify technologies and latent market opportunities that are most likely to generate benefits for SA;
- develop consensus on future priorities amongst the different stakeholders in selected sectors (industrial, socio-economic or service);
- co-ordinate the research effort between different players within selected sectors;
- reach agreement on those actions that are needed in different sectors to take full advantage on existing and future technologies.

Equally as important as these outcomes, was the foresight process itself, which brought together government departments, industry, science councils, higher education, organised labour, professional organisations and other stakeholders, who previously related to each other in a highly fragmented way¹⁴.

The foresight project mission was to promote technological innovation and deployment by identifying opportunities for economic and social development through the National Research and Technology Foresight Project already described. To accomplish it, twelve foresight sectors were identified, being "Health" one of these sectors. The "Foresight Health Sector" is one of the twelve reports sector resulted from the SA's National Research Technology Foresight Project. This paper will only focus the health sector report, generated during the foresight exercise.

According to the World Bank, SA is a middle-income country, and 8,5% of its GDP is spent on health care, of which as much as 60% is spent in the private sector. The Medical Aid Schemes industry has shown healthy growth for most of the past 10 years. Currently, 7.5 million lives are covered by some form of medical insurance, and medical aid schemes spent around R20 billion in 1997. The public sector has to take care of the health needs of the rest of the population¹⁵.

The main problem was that in health sector, the statistics where not updated and available, which was leading into decisions that would not reflect the reality of the country. Due to the unique features of SA, the Ministry felt that a foresight exercise had to be adapted. As a result, the Foresight Programme was deliberately designed to involve the extent of a wider community such industry, government, labour and civil society, within a participatory approach.

¹⁴ See: <http://www.dst.gov.za/index.php/resource-center/foresight-reports>

¹⁵ According to the Report

It was formed a Health Sector Working Group (HSWG), with the mission of prioritise research and technology strategies in the SA Health sector, in order to ensure a sustainable development in the country. This Working Group focused on six areas:

- Health policy and legislation
- Measurement and health information
- Education and training
- Health promoting activities
- Health technology
- Health services.

And had the responsibility to:

- agree on proposed sector foci;
- analyse the current status of the sector;
- identify the future challenges and trends that may affect the health sector;
- identify research and technology approaches that address these challenges and trends;
- make recommendations on the identified cross-cutting issues/areas; and
- compile a prioritised list of research and technology topics.

Methodology

Based on the outcomes of a series of workshops, the HSWG identified four research and technology themes that should be the core of the Research and Development effort for the next 10 years: 1) Health information system; 2) Health service delivery; 3) Self-management Technologies and 4) Cost-effective prevention and treatment technologies.

The methodological approach in the foresight exercise used a combination of techniques, which included SWOT analysis, scenario analysis and survey of opinion on research and technology trends.

In order for the HSWG obtain an overview of the current research and technology status in the health sector, studies of international and current trends were done. The International Study examines current technological, market, policy and strategic trends of the health sector internationally, while the Local Study reviews the current status of the health sector in SA particularly with regard to research and technology.

SWOT Analysis

A situational analysis of the internal and external environment of the SA Health Sector was done on the basis of the information contained in the International and Local Studies, as well as the knowledge of the members of the HSWG.

The SWOT analysis technique was used to: match the environmental threats and opportunities with the weaknesses and especially strengths within the Health Sector; identify relationships between these factors and base strategies on them; use this rational systematic approach to anticipate, respond to and even alter the future environment.

Opportunities and threats originate the external environment. They are the issues that make the external environment attractive or unattractive. They influence the way people react to the external environment. Strengths and weaknesses originate within an organisation or structure, and take into account resources, advantages and deficiencies, as well as relative standing with regard to 'competitors'. The results of the SWOT analysis were presented taking into account the parameters (Figure 8):



Figure 8- SWOT Analysis results

Macro-Scenarios

In order to contextualize all sectors, macro-scenarios were developed to provide for a uniform frame of reference for all sectors, over a 20 year period. Scenarios are stories about possible futures, that is, what could happen, and not *will* or *should* happen. They are internally-consistent hypotheses about the future and are not predictions or forecasts. Scenarios are useful if they are relevant, novel, plausible and clear.

The foresight macro-scenarios were developed to assist in identifying research topics, technologies and market opportunities that are likely to generate maximum benefits for SA in the next 10 to 20 years. These macro-scenarios were useful in identifying the key concerns of opinion-makers and improving the quality of strategic debate by creating a common concept of the future. Four macro-scenarios were used as reference points to develop the more focused Health Sector scenarios: "Global Home", "Frozen Revolution", "Our way is the way" and "Innovation Hub". As an example, macro-scenario "Global Home" describes:

"In line with global trends and opportunities, government embraces global liberalisation, and facilitates private-sector empowerment to respond to global market forces, leading to a 'hands-off' role for government, with initially good economic growth. This is fine for those who are able to pay, but internally, this result in limited social development and a loss of national identity and self-determination." (p.33)

Another example is "Our way is the way":

"South Africa believes in its ability to challenge the conventional route to globalisation by rallying developing countries' support for the development of a significant South-South economic bloc. This catalyses isolation by the developed world." (p.33)

Scenarios are based on current key uncertainty areas. The HSWG was asked, to list key concerns within the health sector, who then grouped the following final list was generated:

1. What will the budget for health care be?
2. The type of health-care delivery (including private/public cooperation).
3. The level of crime and corruption within the public and private health-care industry.
4. The process of policy formulation that will be followed.
5. The capacity within the country to implement policy and priorities.
6. Changes in the burden of disease.
7. The level of research.
8. The change in social values.
9. The impact of demographic change.
10. Damage to the academic health sector and health services.
11. Development of health information delivery systems.
12. The extent of rational health care.
13. The impact of new technologies.

These key concerns were then used to develop health-sector-specific scenarios within the context of the macro-scenarios. As an example, for:

"Global Home" - "In this scenario there is increased economic growth, but government spending on health care decreases, with an increased reliance on the private health-care system. Foreign technology is imported and health-care options are increased, with a private academic health sector developing. (...) International policies are adopted, but they are not always relevant." (p.34)

"Our way is the way" - "As a result of the isolation, slow economic growth leads to limited funds being available for public and private health care and more collaboration between the public and private health sectors. Local technology is developed, with more emphasis on indigenous knowledge." (p. 35)

Based on these four scenarios, the HSWG was requested to go through a process in which they assumed that the scenarios were occurring and the sector was as it is now. Then they were asked to do a SWOT analysis. The result of this analysis would then be used in the future when robust research and technology topics are identified.

Survey Analysis

The aim of this survey was to identify the long-term research and technology needs of the health sector in SA. The survey elicited the views of pre-selected participants regarding the importance, timing, opportunities and constraints of specific energy-related and some crosscutting topics.

Two response options were available to the respondents. They could either complete a paper-based postal questionnaire, or make use of an internet-based survey instrument to enter their responses directly into a computerised database.

Regarding the structure of the questionnaire, it addressed 72 topics¹⁶ corresponding to 72 statements related to the state of technology development. After the results treatment, a list for the top of the first 20 topics and 10 of the last topics, based on the index of quality of life was established.

Starting with these 20 statements list, 10 items were selected based on a composite indicator made from all the variables used so far. The composite indicator allowed analysts to calculate the weight of each topic that was more

¹⁶ These 72 topics were divided in a total of 15 sub-section, as: health policy information systems, Health promotion, vaccines, research....

important to SA in terms of wealth creation and quality of life. As a result the 10 most promising topics in terms of this composite indicator were obtained (Table 3):

Rank-order position	Topic No.	Topic description	Potential index	Importance index	Confidence index	Composite index
1	42	An effective HIV/ AIDS vaccine is available	67	95	91	86
2	38	Health promotion: The development of a school-based health promotion system that will enable children to take responsibility for their own health	65	90	90	81
3	1	Health policy: The development of a novel Health-care Delivery System that optimises interaction between the public and the private sector	66	87	91	79
4	62	Development of cheap, rapid, easy-to-use on-site diagnostic tools for rural clinics and hospitals (e.g. urine dipstick for HIV/ AIDS and other sexually transmitted diseases)	72	89	87	77
5	43	Development of a malaria vaccine	71	91	84	76
6	39	South Africa is a major exporter of health-technology packages, including devices, training of technicians, and technical support, to sub-Saharan Africa	68	87	88	76
7	72	International pharmaceutical companies conduct more research in South Africa because of unique local expertise in HIV/ AIDS and hypertension, and the technological and research infrastructure	73	84	90	76
8	47	Development of an effective prophylactic for tuberculosis	71	93	81	75
9	49	Widespread use (locally and internationally) of specific South African developed drugs	69	91	83	75
10	14	Widespread utilisation of Health Management Information Systems to help with the monitoring of health status, drug utilisation and health planning	65	84	89	75

Table 3- The 10 most promising topics in terms of the composite indicator (Karim, 2000)

In conclusion, the methodology used made possible to identify research and development issues and priorities based on the results of the survey of the top twenty research and development priorities for SA. In the end, 23 TOP Research and Development Issues was established. The methodology used in this exercise was synthesized in Figure 9:

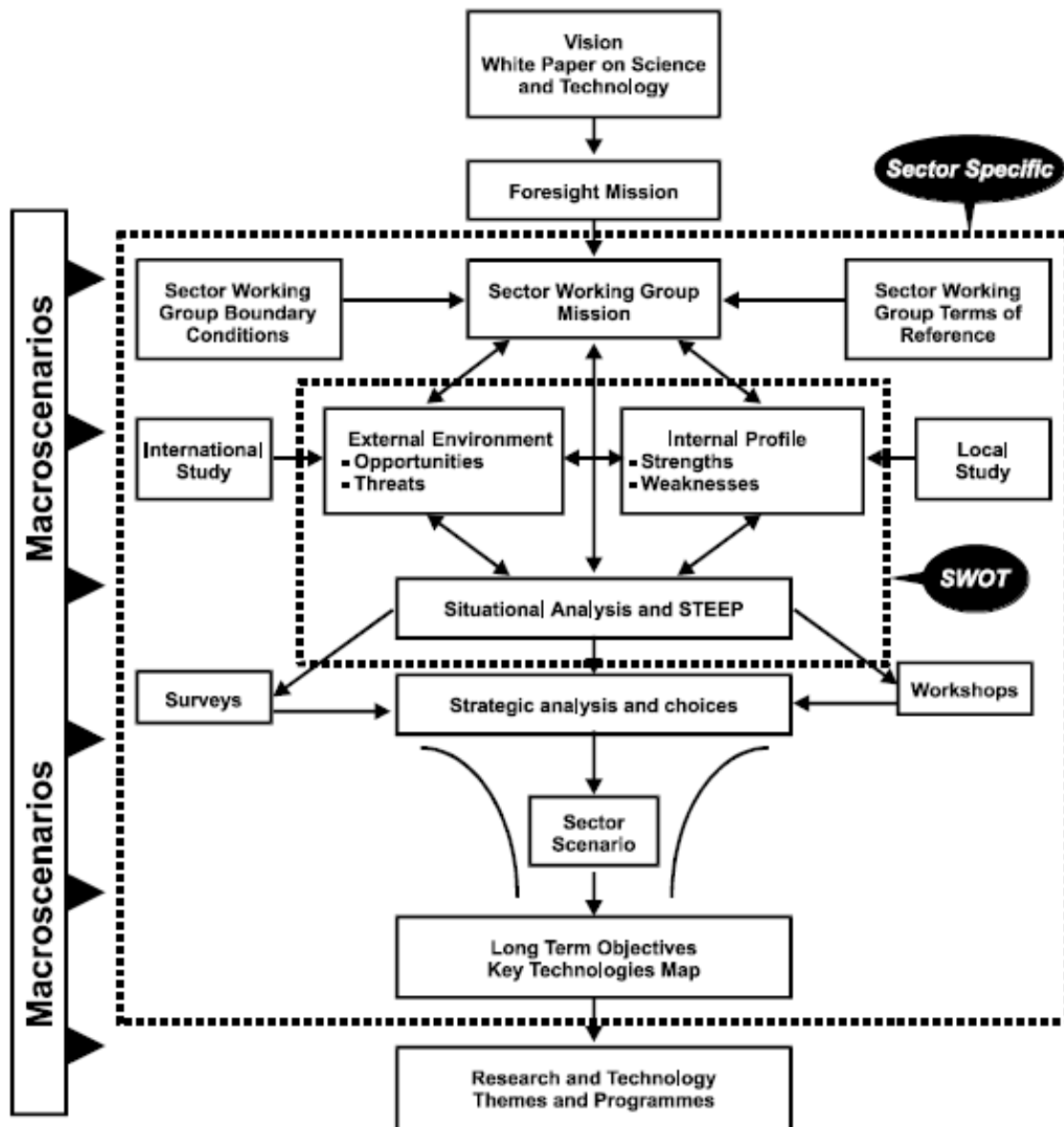


Figure 9 - Detailed foresight methodology (Karim, 2000)

Outputs

In the end of the process, the Foresight HSWG was able to deliver a report that made some recommendations on the science and technology challenges in providing health care in SA from a medium to long-term perspective. These recommendations were clustered in to four major themes initially identified by the Working Group: 1) Health Information System, 2) Health Service Delivery, 3) Personal Health Care Technologies and 4) Cost-effective Prevention and Treatment Technologies.

Conclusions

The foresight exercise attempted to address the science and technology challenges that would be focused in providing health care in SA from medium-to-long term perspective. It provided a valuable mechanism for serious consideration of significant technical trends and their relationship to socio-economic needs. The exercise was inherently proactive and reflects the belief that the future is influenced by today's decisions and actions. By building complex pictures of alternative futures SA was better able to assess how well current research and technology systems might address their future needs.

Discussion and conclusion

Two study cases were presented using two different foresight methodologies: one qualitative and other quantitative. When it comes to foresight exercises applied to health, five promising methods can be identified. The presented case-studies illustrate the use of forecasting and scenarios as two methods to aid decision-making. A comparison table (Table 4) was drawn for a more simple analysis of both case-studies:

CASE STUDY 1	
Aim	Clear problem definition Clear identification of need and aim Timeline identified (14 years)
Method	Forecasting Extrapolation
Stakeholders	Ministry of Health and Long-Term Care SAS Institute
Outputs	Report

CASE STUDY 2	
Aim	Clear problem definition Clear identification of need and aim Timeline identified (10-20 years)
Method	SWOT Analysis Scenario Analysis Survey
Stakeholders	Health Sector Working Group Industry Government Labour and civil society
Outputs	Report

Table 4 - Comparison of the two case-studies

In the first case study, due to the rising needs on hip replacement surgery a foresight study was needed to guide the decision-making strategies to take in terms of different investments approaches. The method used was the trend extrapolation which, is one of the longest-established tools of forecasting. According to Popper (2008) it provide a rough idea of how past and present developments may look like in the future, seen as extensions of patterns that have been previously observed. That means that extrapolate is to infer the future from the past. Giving the present case, if there has been a steady stream of technological change (number of hip replacement surgeries) and improvement, it is reasonable to assume that the stream will continue to now. It can also uses statistical methods in order to predict futures patterns of time series data.

This method has some advantages: it is quick and easy to work with (in a basic level), it can be taught and learned, and it can be peer reviewed. It facilitates strategy and decision-making and it enables the creation of challenges to existing paradigms and resource constraints. On the other hand, there are also some disadvantages like the fact that new technical approaches can replace the forecasting assumptions.

In the second case-study, a broader vision of the future was needed (in total six areas) therefore the exercise was to complex, evolving many variables. It was based in three different methods.

Taking into consideration Popper's (2008) definition (resources, capabilities, etc.) and classifies them in terms of Strengths and Weaknesses. It also examines and classifies external factors and presents them in terms of Opportunities and Threats. All these facts together are useful to explore possible strategies for decision-making. This is the reason why the acronym of this method is SWOT: (s)trengths, (w)eaknesses, (o)pportunities and (t)hreats.

Scenario analysis refers to the wide range of approaches involving the

construction of scenarios, or plausible future states of affairs (Popper 2008). Scenarios are seen as a predicted sequence of events that might possibly occur in the future. Surveys are widely used in foresight exercises. It is characterized by the distribution or availability of a questionnaire aimed to information of opinion targeting a specific group or a general one. All of these methods have their own pros and cons, but when applied together they tend to diminish eventual gaps.

In both cases three very important aspects were taken into consideration: the need to have a clear definition of the problem, a clear identification of need and aim for the exercise and well defined timeline identified. Both exercises ended by the release of a final report in order to share conclusions.

In terms of final thoughts, one can say that a foresight exercise should be action-oriented. That means that the exercise results only is plausible if it can actually help to shape the future. And for that reason it also should be open to alternative futures. Since it does not take into consideration a pre determine future, the future therefore can indeed take different directions and so different alternatives.

In medicine, the problems encountered cannot be reduced to only one dimension. For that matter foresight exercises should be multidisciplinary and take into consideration different areas and variables. And should also be participatory just to make sure that the right stakeholders are involved and for that matter different groups of actors evolved and concerned that the issues at stake.

Policy makers can only improve their decision-making process if they are provided with a better understanding of the future supported in evidences and based information. This information can be given through TA foresight studies.

If policy makers take into consideration foresight studies then, they can improve policy-making, through higher ability to understand and shape the future, adding credibility and evidence to their decisions.

Foresight improves the impact of decision-making and also its quality, by improving strategic decisions. By providing a variety of outcomes, foresight can improve decision-making implementation and the ability to cope with future challenges in health care.

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